GPS measurement of postseismic deformation associated with the Northridge earthquake

Andrea Donnellan (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, 91109; ph. 818-354-4737; e-mail: andrea@cobra.jpl.nasa.gov); Gregory A. Lyzenga (Harvey Mudd College, Claremont, CA, 91711; ph. 909-621-8378; e-mail: lyzenga@thuban.ac.hmc.edu); Bradford H. Hager (Massachusetts Institute of Technology, Cambridge, MA, 02139; ph. 617-253-0126; e-mail: brad@meinesz.mit.edu)

GPS measurements collected over six months following the 1994 Northridge earthquake suggest that little north-south postseismic motion is occurring over the fault plane, while significant motion is occurring approximately 15–20 km from the rupture plane. GPS stations located over and near the assumed rupture plane show little north-south postseismic motion except for that attributable to aftershocks. Two M $\sim$ 5 aftershocks occurring January 29 and March 20 affected only the stations within 5 km of each epicenter. Oat Mountain moved 40 mm southward in the January 29 aftershock and Cal State University Northridge moved 4 mm north in the March 20 aftershock. The motion observed in both of these cases is consistent with elastic models of the aftershock mechanisms. Motions of stations near the Ventura basin suggest significant right-lateral shearing across the eastern basin of about 40 mm in the six months following the earthquake. The shearing is consistent with either right-lateral shear on the fault rupture plane or on the upward extension of the plane. We also observe about 19 mm of north-south shortening between two stations located about one fault length (15–20 km) northwest and southwest of the fault plane during the six months following the earthquake, The shortening decreases away from the fault plane. These results are consistent with a postseismic relaxation time scale on the order of decades, This estimate of the relaxation time is consistent with results from viscoelastic models of GPS measurements collected prior to the earthquake.